that we otherwise routinely accept in a technological society. The Federal Radiation Council (which is composed of the Secretaries of Health, Education, and Welfare, Labor, Agriculture, Commerce, and Defense, along with the Chairman of the AEC and the Special Assistant to the President for Science and Technology) has until recently been responsible for setting these standards. It was the FRC that made the recommendations on which the AEC based its control regulations. That these recommendations are essentially identical with those of the National Council on Radiation Protection and Measurements and the International Commission on Radiological Protection should come as no surprise. Most of those who have prepared reports for the FRC have been members of the NCRP, and many members of the NCRP committee were also members of the corresponding ICRP committee (*3*, p. 28).

Gofman and Tamplin repeatedly make the point that the FRC has not always been an effective mechanism for protecting the public health from unnecessary radiation exposure. For example the FRC for a long time allowed the uranium miners in Colorado to be exposed to radiation that was 10 to 100 times the limit set by the ICRP (*3*, p. 26). Even after the Public Health Service drew attention to the problem the FRC was slow in taking action. At present, one of its most glaring failures is in ignoring excessive and unnecessary medical exposures. Studies have indicated that medical exposures, which now account for 90 percent of man-made exposures in the United States, could be reduced by a factor of 10 with very little effort (*3*, p. 27). Such excessive exposures could be prevented by effective action at the federal level. Furthermore, at the present time medical exposures are not included in the 170-millirem exposure suggested by the FRC. We think they should be.

The authors continually charge that the mechanisms for setting environmental safety standards (such as the FRC) are inadequate in that they too often focus on the short-term benefits of technology rather than the possible long-term adverse effects. They call for more public discussion and participation in weighing the costs and benefits of atomic energy and indeed of any new technology. They also call for new institutions in which independently financed scientists would serve as adversaries against the promoters of new technology. In these suggestions the authors are certainly not alone. We personally agree that there is an urgent need for participation by a well-informed public in future decision making.

The "technological assessment" of nuclear energy by the public has already begun. There are numerous court interventions all over the country in which citizens are asking for lower emission standards for nuclear power plants. Such reductions seem to be technically feasible. Both General Electric and Westinghouse offer augmented air- and water-treatment packages for their reactors which would add only about 1 percent to the cost of the plant. Should such devices be required on all nuclear power plants? Are they only "possible," in the words of the AEC, or are they also "practicable"—meaning economically feasible in some sense? Should the public—the consumers of electricity and the potential victims of radiation exposure—have some voice in this decision?

An important issue that the authors mention and that has not yet received the public attention it deserves is the need for some reasoned policy with regard to the future energy requirements of our society. Do we in fact need to increase our electric power consumption at the present rate of 9 percent a year while the population is growing at 1 percent a year?

We are still at the beginning of the nuclear age. In view of our limited ability to assess all the consequences of technological innovation we would be wise to exercise greater caution than has been so far manifested in setting environmental standards. Failure to do so in the case of radiation standards would appear to be singularly irresponsible, since there is little doubt that exposure limits in the United States could be substantially reduced without forcing people to live by candlelight in caves. Gofman and Tamplin have raised serious questions concerning the basis for and the mechanisms of technology assessment. We hope that the attention these questions demand will not be diverted because of their passionate and intemperate rhetoric.

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Apollo's Baggage

Moon Rocks. HENRY S. F. COOPER, JR. Dial, New York, 1970. x, 198 pp. + plates. $5.95.

The Lunar Rocks. BRIAN MASON and WILLIAM G. MELSON. Wiley-Interscience, New York, 1970. x, 180 pp., illus. $8.95.

These two accounts of the most carefully studied (and expensive) rock collections in history are surprisingly complementary. Cooper's journal gives some insight into the personalities and motivations of the men selected to examine the lunar samples, whereas Mason and Melson give a summary of the facts and theories derived from those samples as of January 1970.

Cooper's style is informative and has that delicious flavor of hot gossip characteristic of profiles and reports found in the *New Yorker*. I was grateful to Cooper when the installments of his book appeared there for his appraisal of what my colleagues were doing in the LRL (Lunar Receiving Laboratory), and I am now again grateful for this collection of anecdotes about those trying and hectic weeks.

Cooper uses confrontation as a stage drop for his journal, and his protagonists accuse each other of a variety of intellectual vices as they discuss whether the moon is hot or cold. (Most people I knew thought it was lukewarm, but such wishy-washy attitudes are not good journalism.) He follows a few individuals through the events of moon walk, initial examination of the rocks, and the lunar conference in Houston in January 1970. The choice of individuals is apparently those who would take time to talk or those whose reputations cannot be overlooked.

We get a fair spread of scientific styles, and the sense of hierarchy comes through very clearly as theoreticians, analysts, and natural scientists are suspicious of each other's competence. Cooper was not in a position to see much of the history of the LRL, and it is sad to realize we may never get a set of memoirs from the principals

who designed, ran, used, and were imprisoned in that sterile place. This book does not reveal enough of the decision-making processes to enable us really to understand why the LRL operates as it does. The NASA system, clearly dominated by engineers, can be frustrating for scientists who are more curious about the moon than they are interested in the means of getting there. Although some of these management conflicts surface in Cooper's record, they are never dissected to reveal who in the NASA administration is scientist or engineer, or for that matter how much in each of us is scientist or engineer. The trips to the moon and the aftermath are a truly interdisciplinary effort, and it seems unfortunate that some members of the team are unable either to absorb the detail or to learn the reasoning behind their colleagues' ideas.

Such criticism cannot be leveled at Mason and Melson, who have captured the better part of the Apollo 11 scientific results in their book, *The Lunar Rocks*. Mason has offered two earlier texts, on geochemistry and on meteorites, of high quality, and this volume maintains the high standards of clarity and objectivity characteristic of those earlier works. Melson's contributions are not easily distinguished from Mason's, and the book is a uniform, coherent entity.

We are given complete résumés of the mineralogy and petrography of the lunar rocks, and an element-by-element discussion of the chemistry of these rocks. There are abundant facts, photomicrographs, and some convenient summaries of data. For someone who has only a peripheral interest in the moon, this volume is recommended as an excellent summary of the data available as of January 1970. It is a little weak in describing the general context of the rocks sampled, and I think the discussions on isotope geochemistry, physical properties (excepting magnetism), and lunar stratigraphy are inadequate. I also think that the usefulness of elemental and isotopic abundances in rejecting or adopting lunar theories should be discussed in the context of those theories, rather than in a periodic encyclopedia of the elements.

Unfortunately, the volume is already obsolete. Lunar petrology is moving at a rapid pace. NASA has required fast publication of results, and the field is highly competitive. A similar text could be published every year throughout the next five years and become obsolete each year. I hope these authors will update their effort, for it is a useful book.

Whether there is a real need for such updating is dependent on decisions in the higher levels of government. It would seem that activities such as lunar exploration could be supported in times when 90 percent of us are not engaged in producing goods needed for survival. Moon workers help sate our curiosity, provide many and varied peripheral jobs, and are not especially wasteful of our natural resources. I am personally grateful to all of those workers, and these two books provide some explanations why.

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Bacterial Activity

Biochemistry of the Phagocytic Process. Localization and the Role of Myeloperoxidase and the Mechanism of the Halogenation Reaction. A symposium, Miami, Jan. 1969. JULIUS SCHULTZ, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1970. 142 pp., illus. $8.

When a leukocyte ingests a microbe its protective action against infection in the whole animal is expressed by its ability to kill the bacterium. At least a part of that bactericidal activity is due to one or another metabolic product of the phagocyte itself, as was revealed some years ago by Dubos with respect to lactic acid. In very recent years work from several laboratories has indicated that hydrogen peroxide might be a metabolic product with particularly important bactericidal activity. This is especially intriguing in at least one class of phagocytes, the polymorphonuclear leukocytes, where there is a very large amount of a particular peroxidase, myeloperoxidase. The function of this enzyme was not really known until quite recently. The chapter by Klebanoff in this volume, on myeloperoxidase-mediated bactericidal phenomena, summarizes the evidence for the participation of hydrogen peroxide, a halide (particularly iodide), and myeloperoxidase in a potent bactericidal system, ascribing a real and important function to the peroxidase. The enzyme has been known for some years to be localized in the intact cell in a lysosome-like granule which voids its contents into the phagocytic vesicle, that is, into the intracellular "chamber" in which the ingested bacterium is contained. While the source of the enzyme in the phagocytic vesicle or vacuole is known, the origin of the hydrogen peroxide is currently the subject of some controversy. The hydrogen peroxide is, however, widely considered to be formed by cytochrome-independent oxidation of reduced pyridine nucleotides. The availability of the latter increases during the metabolic burst that accompanies the ingestion of particles—bactericidal or otherwise.

Indeed, if one examines the whole process of phagocytosis, one is struck by the fact that the metabolic reactions that are stimulated as the cell ingests the solid object have three purposes. In the leukocyte these are: provision of energy for the ingestion process itself; provision of energy and building blocks for repair and maintenance reactions, for example at the cellular membrane; and provision of hydrogen peroxide for bactericidal activity. Our insight into these matters is now rapidly increasing, but it should be borne in mind that not all leukocytes have peroxidase-mediated bactericidal activity and that, even in the polymorphonuclear leukocytes, this system is almost certainly not the only one that attacks the ingested bacterium. The role of the phagocytins (basic proteins that are also granule-bound) which have been studied by Hirsch and Spitznagel, among others, must be taken into account.

The book contains some important and useful information, particularly for those working in the field of bactericidal activity or the peroxidases. The paper of Klebanoff already mentioned refers to a genetic defect in which, as far as one can now judge, the ability of the cells to produce hydrogen peroxide is deficient. In Martin Cline's chapter a hereditary situation is described in which the peroxidase of polymorphonuclear leukocytes is deficient. In both these circumstances microbicidal activity is depressed, presumably because these key components of the system are lacking. These two chapters are closest to the core of the problem defined by the book's title.

The chapter by Schultz and Berger on myeloperoxidase itself and the properties of the granule in which it is contained and that of Baggiolini, Hirsch, and de Duve concerning the general distribution of enzymes in leukocytic granule populations also relate closely to the phagocytic and bacteri-